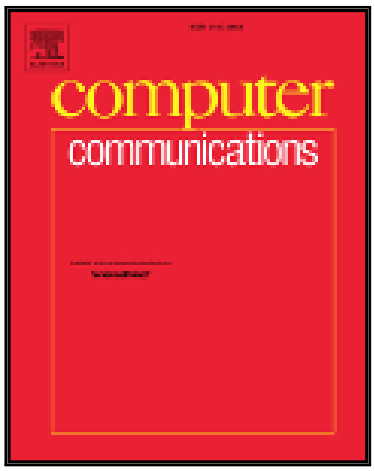

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Modelling and Performance Analysis of TCP Variants for Data Collection in Smart Power Grids

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Abstract

Smart grid communication networks adopt a variety of communication technologies interconnecting numerous and diverse equipment. The requirement of supporting a large traffic volume over such networks efficiently, reliably, and fairly among various applications calls for the study of the effectiveness of the transmission control protocol (TCP). The question raised in this paper is whether various TCP variants perform differently.

We are particularly interested in comparing the performance of TCP-Reno and TCP-Vegas variants when handling sensory and metering traffic. The former variant follows a loss-based congestion control mechanism while the latter adds delay-based enhancements. Contrary to expectations, our simulation and analytical comparison results show that TCP-Reno outperforms TCP-Vegas in terms of packet loss rate. However, to take advantage of Vegas' added features, a previously proposed scheme named split- and aggregated-TCP (SA-TCP) is recommended. The scheme splits meters' TCP connections at intermediate devices and forwards collected data over an aggregated TCP connection to a data center.

Keywords: smart power grid, smart metering infrastructure, congestion control, telecommunication traffic

1. Introduction

In a smart power grid, information is gathered from a large number of intelligent electronic devices (e.g., smart meters, phasor management units (PMUs), remote terminal units (RTUs), and other sensors) for the purpose of facilitating new capabilities, such as the integration of renewable energy sources, self-healing of the grid, efficient generation and provisioning of improved power quality [1, 2, 3].

The amount of traffic is indeed significant as metering and sensing devices will be remotely controlled, configured, and read in a periodical, on-demand, and event-driven fashion. A variety of applications with different characteristics and requirements [4, 5] share the grid's communication network (Fig. 1). Thus, regardless of whether a public or utility-owned communication network is employed, it is essential that communication protocols provide services such as fairness among the flows of traffic, congestion control and reliability [6, 4, 7, 8].

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